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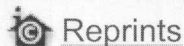90nm ARM9 microcontroller

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[Design Briefs]
Divide And Conquer The Resistive Divider

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The resistive voltage divider—a basic circuit taught in every introductory electronics course—may cause some problems during its implementation. If you've ever stood in front of a resistor kit while punching values into your calculator, this article is for you.

Typical kits don't include every value. So, finding an elusive ratio for which both values are commonly available can be a challenge. The small spreadsheet described below not only provides a table of 1% resistor values, it also makes it a snap to find the ratio you need using two available resistors.

Most engineers don't know that 1% resistor values are logarithmically spaced in increments of exactly 1/96th of a decade. Figure 1 shows a spreadsheet table of 1% resistor values, rounded to three significant digits. For example, the formula in cell B5 is =10^((B$4+$A5)/96), which is copied to B5 through G20. Only the yellow highlighted values are commonly available in resistor kits. A typical kit contains slightly more than one-fourth of the values.

In a typical application for resistive dividers, the divider ratio R2/(R1 + R2) supplies external feedback to the 4-MHz regulated stepdown converter (Fig. 2). (The feedback threshold at the FB terminal is 0.6 V, and the desired output is 1.5 V.)

To calculate values for R1 and R2, enter the regulator's desired output voltage (voltage at the top of the divider) in cell B3 and the regulator's feedback threshold (voltage at the divider midpoint) in cell C3. Then, the spreadsheet formula in cell D3 is =96*LOG(B3/C3-1), which returns a value of +16.9 steps for this example. That result is the number of 1% resistor-value steps separating R1 from R2.

Therefore, if you use R2 = 100 kΩ (cell B5), you would move +17 steps down the list to R1 = 150 kΩ (cell C6). That would be a good choice because both

resistors are highlighted in yellow (commonly available). Very quickly from the spreadsheet table, you can see that R2 = 110 kΩ isn't a good choice for this example because R1 = 165 kΩ isn't commonly available. You can also quickly identify an exhaustive list of commonly available resistor values that would be suitable: 1.00:1.50, 1.21:1.82, 1.62:2.43, 1.82:2.74, 2.00:3.01, 2.21:3.32, 3.32:4.99, and 4.99:7.50. When the number of steps (D3) is negative, R1 is less than R2. Therefore, you should move in the opposite direction on the value list. In either direction, you may wrap around the list from 9.76 to 1.00, which means that you've moved to the next decade of resistance values. If you use resistive dividers for purposes other than regulator feedback, you may wish to rename cells B2 and C2 as "Vtop" and "Vmid," respectively.
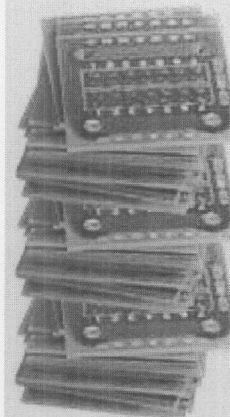
The Figure 1 spreadsheet is available for download in Microsoft Excel format (DB2195XLspreadsheet.xls) and also in Pocket Excel format for Pocket PC (DB2195POCKETXLspreadsheet.PXL), formatted to fit the Pocket PC screen at 60% zoom, at ED Online 12236 at www.electronicdesign.com.

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Figure 1

	A	B	C	D	E	F	G
1	**1% Standard Resistor-Dividers**						
2		Vout	Vfb	Steps			
3		1.5	0.6	16.9			
4		0	16	32	48	64	80
5	0	1.00	1.47	2.15	3.16	4.64	6.81
6	1	1.02	1.50	2.21	3.24	4.75	6.98
7	2	1.05	1.54	2.26	3.32	4.87	7.15
8	3	1.07	1.58	2.32	3.40	4.99	7.32
9	4	1.10	1.62	2.37	3.48	5.11	7.50
10	5	1.13	1.65	2.43	3.57	5.23	7.68
11	6	1.15	1.69	2.49	3.65	5.36	7.87
12	7	1.18	1.74	2.55	3.74	5.49	8.06
13	8	1.21	1.78	2.61	3.83	5.62	8.25
14	9	1.24	1.82	2.67	3.92	5.76	8.45
15	10	1.27	1.87	2.74	4.02	5.90	8.66
16	11	1.30	1.91	2.80	4.12	6.04	8.87
17	12	1.33	1.96	2.87	4.22	6.19	9.09
18	13	1.37	2.00	2.94	4.32	6.34	9.31
19	14	1.40	2.05	3.01	4.42	6.49	9.53
20	15	1.43	2.10	3.09	4.53	6.65	9.76

1. This spreadsheet not only lists 1% resistor values, it also lets you find the divider needed using two commonly available resistors.

Figure 2

Input (2.7 to 5.5 V) — IN — MAX8560 — LX — 1 µH — **Output 1.5 V at 0.5 A**

2.2 µF

MAX8560

ThinSOT

GND — FB (0.6 V)

R1

R2

2.2 µF

On/Off → SHDN

$$V_{FB} = \frac{R2}{R1 + R2} V_{OUT}$$
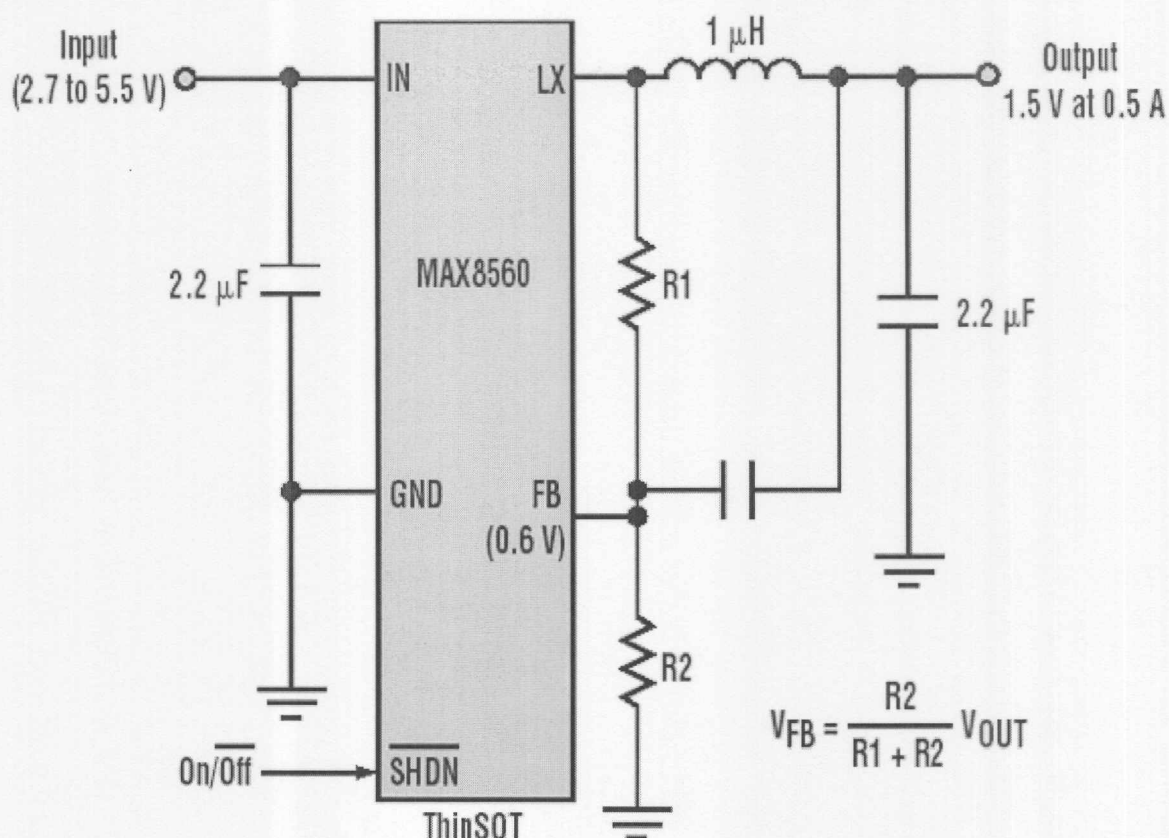
2. The divider ratio R2/(R1 + R2) sets the output voltage for this 4-MHz stepdown regulator. With Figure 1's spreadsheet, you can select R1 and R2 from commonly available values.

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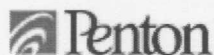www.proven-software.com

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